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Office of the Air Attache

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Synthetic Materials in Aircraft Construction

1. Major General (Engineering Sciences) A. Tumanov wrote in Sovietskaya Aviatsiya, 25 May 1958, of the use of synthetic materials in aircraft construction. Brief comments were made about the TU-104, TU-114, IL-18, and AN-10. According to the anthor, these materials may be used in the form of glass fibers made into a foam plastic for structural strength or a glass textolite for soft fuel tanks. Other items mentioned included perspex for aircraft windows, the use of synthetic glues for bonding metal to metal or non-metallic materials to metal, and epoxide a synthetic resin for metal coating.

2. Comments: This article discusses in a very general way the use of synthetic materials in aircraft construction and may be useful as background information.

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Abridged Translation of
Synthetic Materials in
Aircraft Construction (4 cys)

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SYNTHETIC MATERIALS IN AIRCRAFT CONSTRUCTION

By Major-General, Engineering Services,
A. Tumanov.

Sovetskaya Aviatsiya, 1958, No. 25.

Abridged Translation

Incl 1 to IR 949-58

By Major-General, Engineering Services,
A. Tumanov.

Sovetskaya Aviatsiya, 1958, May 25.

Abridged Translation

Chemistry plays a very important role in aircraft construction. Production of modern aeroplanes is unthinkable without using a great variety of synthetic materials and plastics. Even during the second world war a very high strength timber plastic, "delta-timber", was used for the main stressed components of fighter aircraft. The propeller blades for light aircraft and helicopters are also being made of a timber plastic. Combined with other materials it is used for the interior of the new passenger planes Tu-104, Il-18, An-10 and Tu-114.

In modern aircraft so-called foam plastics are extensively used, the weight of which is many times smaller than even the very light metal magnesium. Due to their good heat and sound insulation properties, they can be used as fillers for internal walls and panels.

When making closed volumes out of sheets, for instance control rudders, it is frequently almost impossible to ensure adequate rigidity and in this case self-foaming plastics are very useful. Introduction of a certain quantity of such plastics into a closed volume and subsequent heating ensures uniform filling of the entire volume, a strong bond of the foam layer with the metal and a high rigidity of the design.

By combining foam layers with stiffening elements "armoured foam layers" are obtained in which veneer, glass-textolite and various sheet metals are used. Such reinforced foam layers are successfully used as fillers in panels faced with veneer in the passenger aircraft Tu-104, Tu-110, Il-18; in addition to increased rigidity and strength, these materials ensure a considerably reduced weight.

It is well known that the problem of reducing the weight

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of aircraft is one of the most [illegible] in aviation engineering. Reduction by even 0.02 g of the specific weight per cubic centimetre of the foam plastic used in the above mentioned aircraft would enable the saving of hundreds of kg of weight in very large aircraft like the Tu-114. According to Soviet Civil Air Line data reduction of the weight of a passenger aircraft by only [illegible] kg produces an annual economy in the operation [illegible] of about 2000 roubles. Consequently the reduction in weight by 300 kg for 100 aircraft leads to an annual economy of about 60 million roubles.

Plastics based on glass fabric, glass fibre and various resins of high specific strength and a number of other properties are extensively used in aviation engineering. Manufacture of large components from glass-textolite by the method of [illegible] applying polyester [illegible] simplify [illegible] technological [illegible] process [illegible] compared to [illegible] of such components from [illegible] metal. In a number of cases a considerable saving [illegible] and [illegible] in the difficulty of manufacture is obtained for a component of equal strength. For instance, the manufacture of containers shaped in one piece from glass textolite [illegible] used [illegible] fuel tanks in aircraft [illegible] by almost 40%.

Use of glass textolite for the bodies [illegible] cameras enables the production of cameras, the lens setting of which does not change as a result of temperature variations since the coefficient of linear expansion of the optical lenses and of the glass textolite housing remain very near to each other. Furthermore, substitution of the met[illegible] textolite ensures a weight reduction of the [illegible] to [illegible]%.

Glass textolites, which also possess valuable radio engineering properties, in combination with foam layers or honeycomb fillers are very useful [illegible] certain temperature [illegible] they are even [illegible] for fairing radio location antennas. [illegible] glass fibres

with artificial resins new thermally stable plastics are obtained from which various parts of aircraft instruments and components are produced by high pressure pressing.

Perspex is used for aircraft windows, this material has good optical properties, a low specific gravity and permits producing components of any configuration and it is stable to the effects of atmospheric conditions. A disadvantage of this material is its high sensitivity to stress concentration. The recently developed method of two-axial orientation of the perspex by drawing it at a temperature exceeding the softening point of glass enabled obtaining a qualitatively new material, without any change in chemical composition, which is free of the above mentioned defect. Synthetic universal and special glues are available which have a strong adhesion to metal and which make gluing one of the most reliable and in many cases the only practicable method of joining non-metallic materials with metals. The emergence of such glues has enabled for the first time the use of glues for joining metals with metals. Gluing of metal components eliminates the disadvantages brought about by rivetting, welding and soldering and, therefore, this method is being used on an increasing scale in aviation and other branches of engineering.

Recently, glues have also been used on a wide scale in complicated designs with fillers when manufacturing friction discs for wheels and also for producing glued-welded and glued-rivetted joints for aircraft and helicopters.

Application of glued joints in the manufacture of helicopter blades enables improving the quality and increasing their lifetime up to double and even more.

Local stress concentrations which occur around rivets, weld spots, etc. distribute uniformly throughout the surface of the joint in the case of glued joints and thereby enables simplification of the design and produces a surface which is smoother than that of rivetted, welded or soldered joints.

New types of synthetic resins, particularly epoxide

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resins, permit using more economic systems of doping aircraft, the coating can be applied directly to the metallic sheathing without using any primer (oil varnish or glyptal zinc chromate primer). Use of such doping systems in modern aviation permits a saving of hundreds of tons of primers and dozens of tons of vegetable oils required for manufacturing them.

It is not possible to enumerate within a short article the great variety of synthetic materials used for aircraft construction but the few examples show clearly the importance of plastics and other synthetic materials in aviation engineering.

The successful fulfilment of the decree of the Central Communist Party on accelerating the development of the chemical industry and particularly of the manufacture of synthetic materials is of great national importance in the Soviet Union.